



**Introduction**

A quantitative gamma-ray spectrometric and aeromagnetic airborne survey of the Northwestern Athabasca Basin, Saskatchewan, was completed by Goldak Airborne Surveys. The survey was flown from June 24th to September 21st, 2010 using two Piper PA-31 Navajo aircraft (C-GJBA, C-GJBG) and one Cessna Caravan (C-GLDX). The nominal traverse length was 100 km, with a maximum airspeed of 400 km/h and a aircraft level clearance of 125 m at airspeed between 200 and 240 km/h. Traverse lines were oriented 135° with orthographic control lines. The flight path was recovered following flight-path differential corrections to a Global Positioning System.

**Gamma-ray Spectrometric Data**

The airborne gamma-ray measurements were made with a Radiation Solutions RS-500 gamma-ray spectrometer using fourteen 102x102x406 mm NaI (Tl) crystals. The main detector array consisted of twelve crystals (total volume 50.4 litres). Two crystals (total volume 3.4 litres), shielded by the main array, were used to detect variations in background radiation caused by atmospheric radon. The system constantly monitors the natural thorium peak for each crystal, and uses a Gaussian least squares algorithm, adjusted the gain for each crystal.

Potassium is measured directly from the 1460 keV gamma-ray photons emitted by  $K^+$ , whereas uranium and thorium are measured indirectly from gamma-ray photons emitted by decay of their radioactive chains. The decay products of the potassium chain are assumed to be in equilibrium with their parents; thus gamma-ray spectrometric measurements of uranium and thorium are referred to as equivalent uranium and equivalent thorium, i.e.,  $U_{eq}$  and  $T_{eq}$ . The energy windows used to measure potassium, uranium and thorium are 1370-1570 keV, 1660-1860 keV, and 2410-2810 keV.

Gamma-ray spectra were recorded at one-second intervals. Data processing followed standard procedures as described in IAEA, 1991 and IAEA, 2003. During processing, the spectra were energy calibrated, and counts were accumulated into the windows described above. Counts from the radon detector were recorded in a 1600 - 1860 keV window and radon was corrected for the time interval. Corrections were made for dead time, basic count rate, and for dose rate. Corrections for the aircraft and atmospheric radon decay products. The window data were then corrected for spectral scattering in the ground, air and detectors. Corrections for deviations from the planned terrain clearance and for variation of temperature and pressure were made prior to conversion to ground concentrations of potassium, uranium and thorium, using factors determined from fits over the Canadian Saskatchewan prairie. The factors for potassium, uranium, and thorium are listed in Table 1.

Table 1 Gamma Ray Spectrometer Sensitivities for aircraft

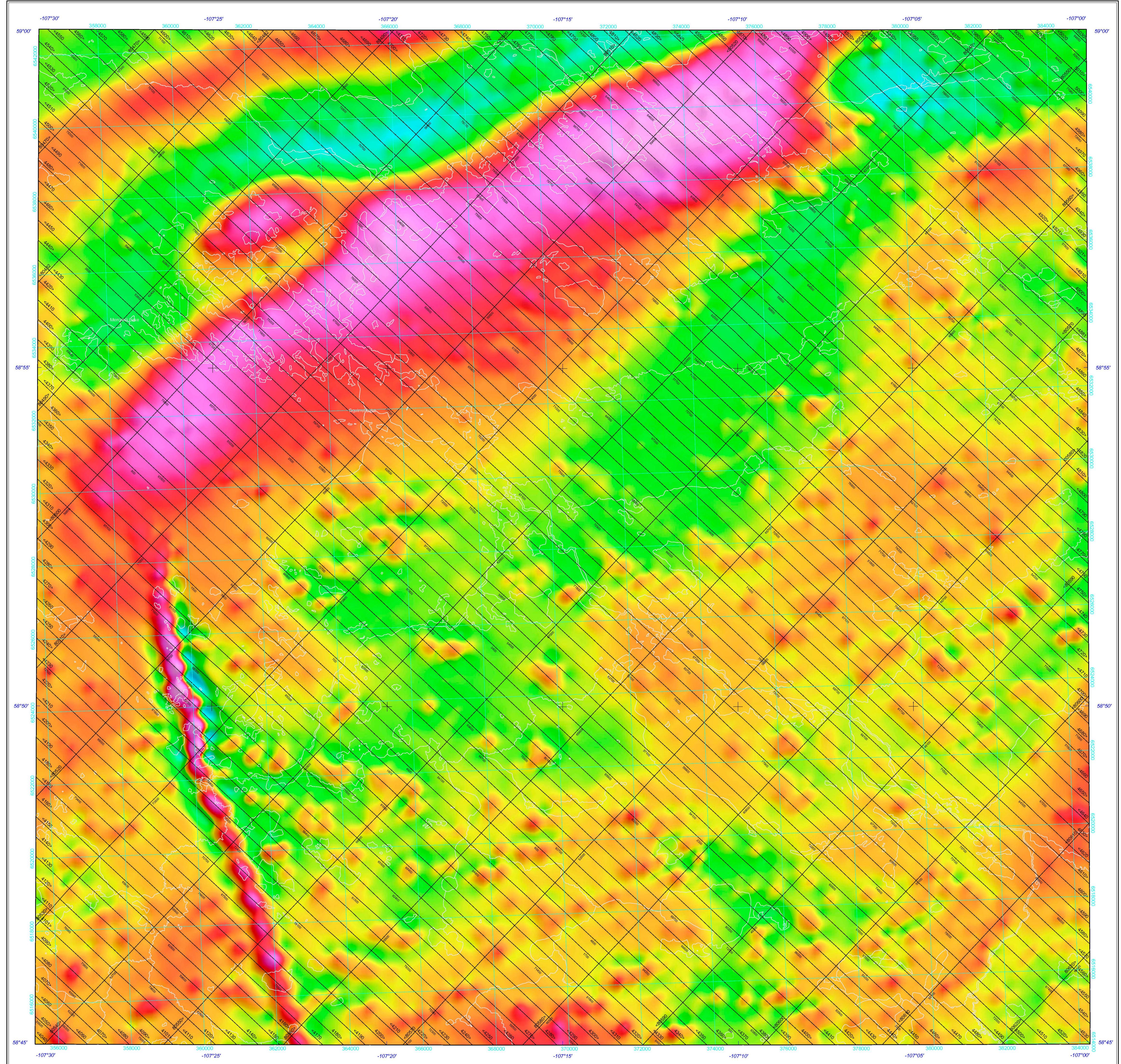
	C-GJBA	C-GJBG	C-GLDX
Potassium (cps/%)	83.27	82.05	99.73
Uranium (cps/ ppm)	0.54	0.53	10.30
Thorium (cps/ ppm)	5.61	5.45	6.57

Corrected data were filtered and interpolated to a 100 m grid interval. The results of an airborne gamma-ray spectrometer survey represent the average surface concentrations that are influenced by varying amounts of overburden, vegetation cover, soil moisture and surface water. As a result the measured concentrations are usually lower than the actual bedrock concentrations. The total air absorbed dose rate in nanograys per hour was produced from measured counts between 400 and 2810 keV.

**Magnetic Data**

The magnetic field was sampled 10 times per second using a split-beam cesium vapour magnetometer (sensitivity = 0.005 nT) rigidly mounted to the aircraft. Differences in magnetic values at the intersections of control and traverse lines were computer-analysed to obtain a mutually levelled set of flight-line magnetic data. The levelled values were then interpolated to a 100 m grid. The International Geometric Reference Field (IGRF) defined as the average GPS altitude of 110 m for the year 2010.61 was then removed. Removal of the IGRF represents the effect of the Earth's magnetic field on the magnetic anomalies within the Earth's crust.

The first vertical derivative of the magnetic field is the rate of change of the magnetic field in the vertical direction. Computation of the first vertical derivative removes long wavelength deviations from the magnetic field and significantly improves the resolution of closely spaced and superposed anomalies. A property of first vertical derivative maps is the coincidence of the zero-value contour with vertical contacts of magnetic units at high magnetic latitudes (Hood, 1965).



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GEOPHYSICAL SERIES / SÉRIE DES CARTES GÉOPHYSIQUES  
AIRBORNE GEOPHYSICAL SURVEY OF THE NORTHWESTERN ATHABasca BASIN, SASKATCHEWAN  
LEVÉ GÉOPHYSIQUE AÉROPORTÉ DE LA PARTIE NORD-OUEST DU BASSIN ATHABasca, SASKATCHEWAN

NTS 74 J14 Squirrel Lake / SNRC 74 J14 Squirrel Lake

FIRST VERTICAL DERIVATIVE OF THE MAGNETIC FIELD  
DÉRIVÉE PREMIÈRE VERTICALE DU CHAMP MAGNÉTIQUE

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Data acquisition, compilation and map production by Goldak Airborne Surveys, Saskatoon, Saskatchewan. Contract and project management by the Geological Survey of Canada, Ottawa, Ontario.

Auteurs : Fortin, R., Coyle, M., Buckle, J.,  
Hefford, S.W. et Delaney, G.

L'acquisition, la compilation des données ainsi que la production des cartes furent effectuées par Goldak Airborne Surveys, Saskatoon, Saskatchewan. La gestion et la supervision du projet furent effectuées par la Commission géologique du Canada, Ottawa, Ontario.



Scale 1:50 000 - Échelle 1/50 000

metres 1000 0 1000 2000 3000 metres

NAD83 / UTM zone 13N

Universal Transverse Mercator Projection  
NAD83 / UTM zone 13N  
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Projection transversale universelle de Mercator  
Système dérivé de la planification canadienne 1983  
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Digital topographic data provided by Geomatics Canada, Natural Resources Canada  
Données topographiques numériques de Geomatics Canada, Ressources naturelles Canada

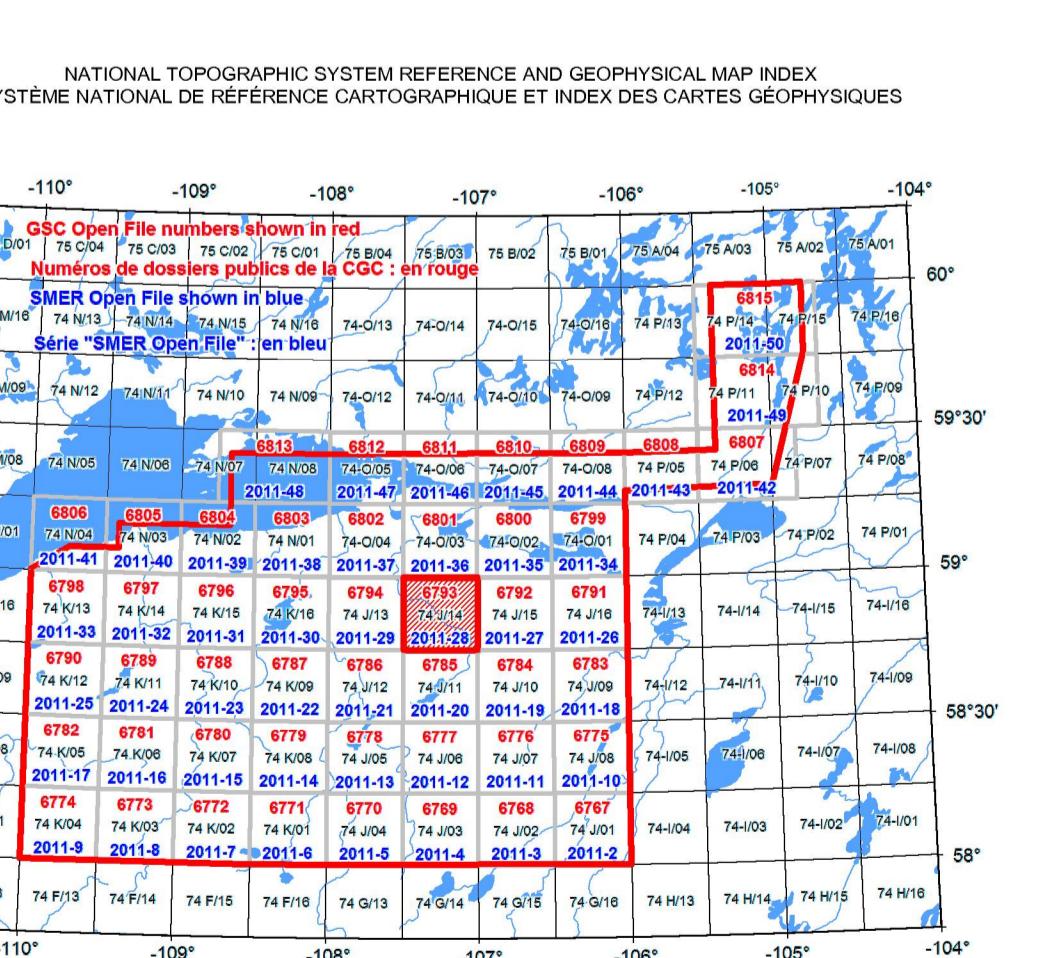
GEM

Saskatchewan  
Ministry of  
Energy and  
Resources

MAP SHEET SUMMARY / SOMMAIRE DES FEUILLES	
Sheet	MAP / CARTE
Feuillet	Taux d'absorption des rayons gamma dans l'air
1.	Natural Air Absorbed Dose Rate
2.	Gamma-ray intensity map
3.	Potassium
4.	Uranium
5.	Thorium
6.	Uranium Thorium
7.	Uranium Potassium
8.	Residual Total Magnetic Field
9.	First Vertical Derivative of the Magnetic Field
10.	Dérivée première verticale du champ magnétique

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GEOLOGICAL SURVEY OF CANADA	Commission géologique du Canada
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NATIONAL TOPOGRAPHIC SYSTEM REFERENCE AND GEOPHYSICAL MAP INDEX  
SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE ET INDEX DES CARTES GÉOPHYSIQUES

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